Lessons Learned on Professional Development for Future Teachers: The Solar System Exploration Pre-service Teacher Institute (SSEPTI)

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NASA Ames

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Professional Development for Pre-service Teachers

Attract and retain students in STEM disciplines through access to better trained and engaging classroom teachers.

- *There exists a need for better trained STEM educators:*
  - Although classroom teachers are often expected to cover Earth and space science as part of state and national science standards, research indicates that without targeted instruction, most pre-service and in-service teachers are likely to have a poor understanding of the space science content, including day and night, seasons, phases of the Moon, the scale of the Solar System, and the scale of the Universe.
  - In a study in which 50 pre-service elementary education teachers were tested as to the causes of day and night, the majority of the teachers (68%) had alternative or incomplete conceptions.

The Challenges

Grade Band	Standard	Student Scores %	Teacher Scores%
5-8	**Earth in the Solar System**		
	The solar system has a star, planets and other objects	51	84
	Solar system objects move predictably	41	84
	Gravity is the key force in the solar system	40	67
	The sun's energy underlies many terrestrial phenomena	33	70
	Stars are fixed relative to each other	33	68
	Planets move relative to stars	33	70
	Telescopes extend our vision	52	89
	Stars are clustered in galaxies	42	100
	Light takes time to travel	36	87
	Standard average	41	79
9-12	**The Origin and Evolution of our Universe**		
	The big bang theory	39	87
	Early star galaxy formation	43	73
	Stellar fusion and its effects	29	88
	Stellar variation	54	94
	Light element formation	34	90
	Heavy element formation	48	84
	Obtaining and analyzing astrophysical data	44	91

From an Astronomy Education Review publication titled, "*The Astronomy and Space Science Concept Inventory: Development and Validation of Assessment Instruments Aligned with the K-12 National Science Standards*," Sadler et al. (2010).

Professional Development for Pre-service Teachers

- Many NASA PD opportunities exist for both in-service and pre-service educators, as well as informal educators.
  - We are partnering with the HEOMD Pre-service Teacher programs to locate resources and leverage best practices.
- Our NLSI Lunar Poles team had successes with the Unknown Moon Institute, PD for STEM middle-school teachers.
  - The content of our VORTICES workshops includes some favorite activities from UMI and also incorporates more on Solar System exploration and the Nature of Science.

Targeting Underrepresented Future Teachers

Teachers often serve as role models to their students.

- APL has experience partnering with Historically Black Colleges and Universities to offer pre-service teacher workshops to students pursuing their education degrees.
- Our workshops' target audience is middle school pre-service science teachers.
- Invitations will be extended to Historically Black Colleges and Universities, Hispanic Serving Institutions, and Tribal Colleges and Universities.
- The institutes will be promoted through LPI's contacts with education faculty nationally from the former Faculty Institutes for NASA Earth and Space Science Education (FINESSE) program and through the Association for Science Teacher Education (ASTE) community.
  - Additionally, we have found that in-service teachers recruited through these communities can serve as role models

2014 Agenda

Day's Theme	SSERVI Content Focus
Day 1 – Introduction to the Solar System	• Explore previous knowledge of the Solar System • Models, scale, seasons and orbits • Scientist presentation on SSERVI themes – exploration and science (Bussey)
Day 2 – Moon Basics and Nature of Science	• Scientific process: observing, inferring, analyzing and sharing results • Lunar orbit, distance and phases • Scientist presentation on Moon observations, lunar geology and formation (Kiefer)
Day 3 - Characteristics of Objects in the Solar System	• Sorting the Solar System, Modeling planetary interiors and differentiation • Asteroid activities • Scientist presentation on Solar System Formation
Day 4 – Solar System Exploration	• Robotic and human exploration • Planning a Mission to the Lunar South Pole • Mission Solar System – engineering activity
Day 5 – Preparing Activities for the Classroom	• Collaborative discussions on using NASA resources in the classroom • Open House with student and families

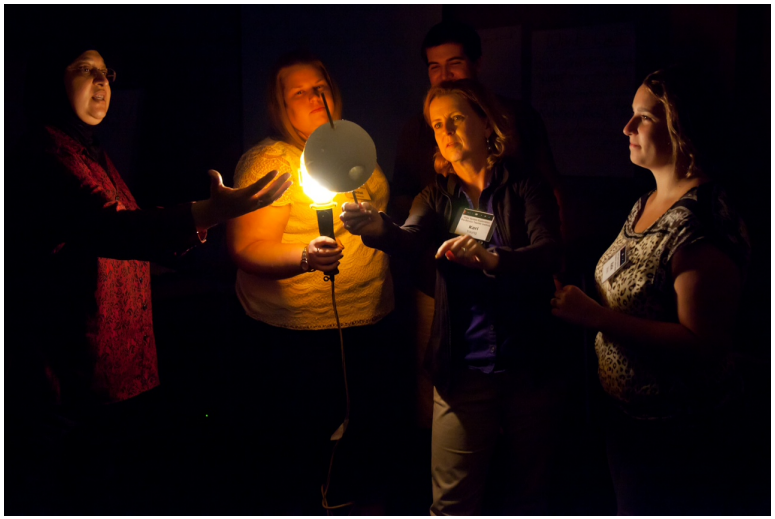
Results from the 2014 SSEPTI

VORTICES first SSEPTI was held June 23-27, 2014 at the Lunar and Planetary Institute (Texas)

16 teachers total participated – 11 of them were Pre-service and the in-service teachers served as mentors

- Participants enjoyed the sharing/interactive aspect of being with other pre-service teachers and current teachers.

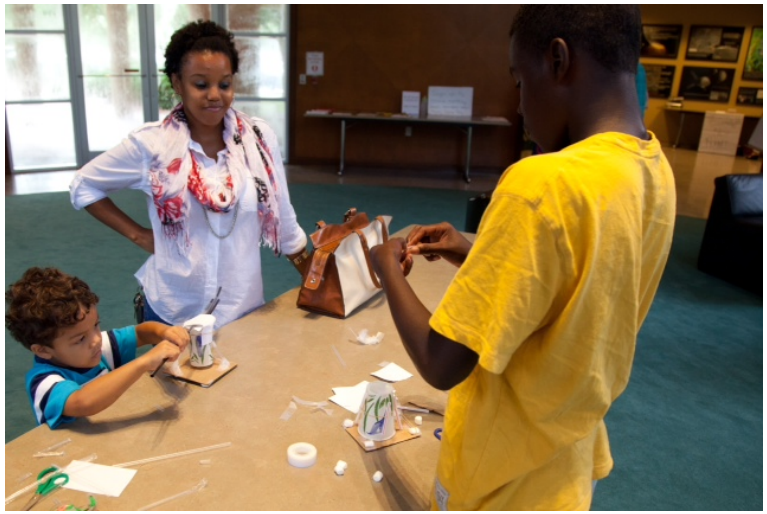
- Participants also valued the interaction with practicing scientists and sharing with the scientists learning how our classroom teaching is used in practice.
    - Also learning current news/missions going on and the research and funding.

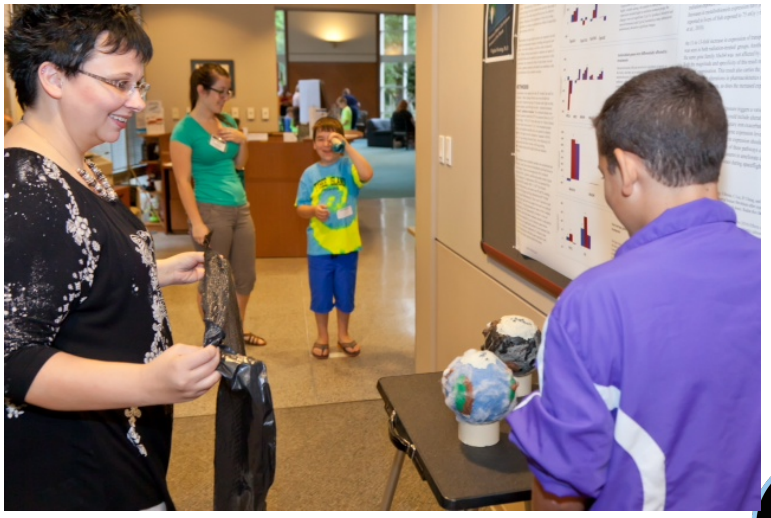


Results from the 2014 SSEPTI

Family Day (55-60 children, parents/ grandparents) was very popular as it allowed student teachers an opportunity to practice what they had learned during the workshop.

- More in depth training on topics and processes that were already familiar, mostly by having a knowledgeable instructor to answer questions.
- Hands-on modeling to share with students are always popular.
- 100% of participant rated the workshop as either excellent or very good.





Looking Ahead

Lessons Learned

- Virtual presentations are good but are better held later in the week.
- Stipends are very helpful!
  - With initial announcement of the application (no stipend), we got about 5 applicants. After we added the stipend to the announcement we got about 20 applicants.
  - Stipends were only given to pre-service teachers.
- Allowing student teachers to practice NASA resources before they go into the classroom gives them more confidence and also allows for valuable feedback for curriculum developers.

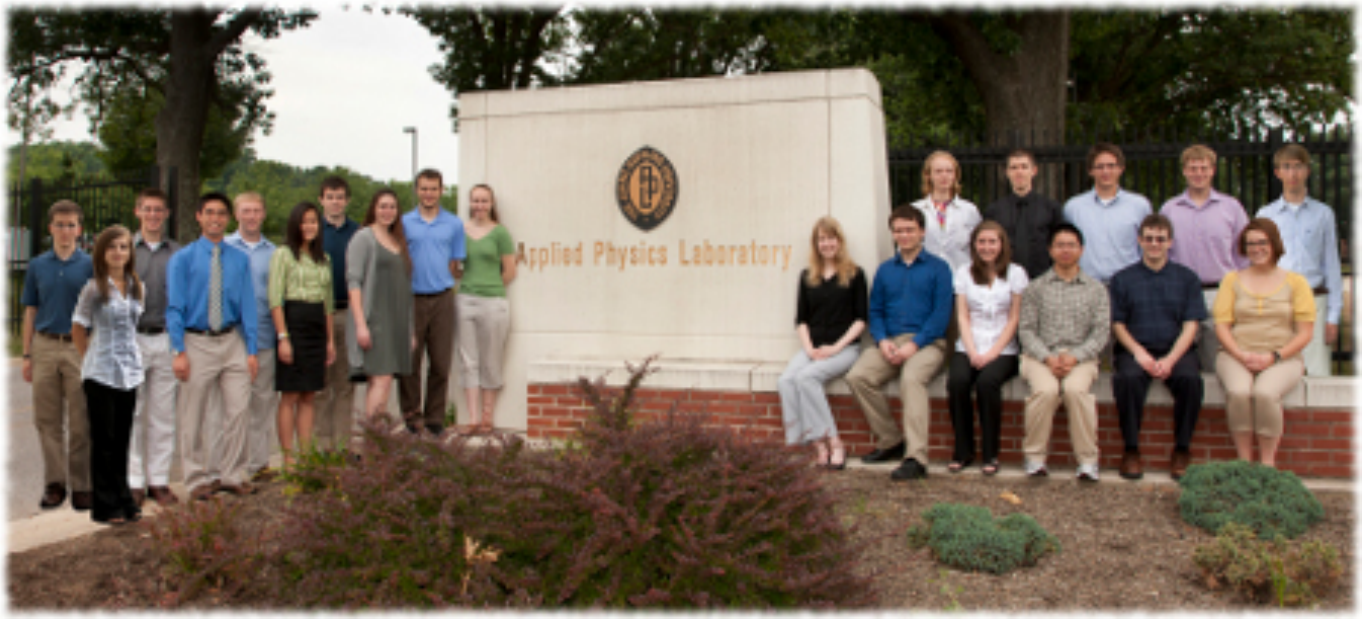
Going Forward

- Given limitation of E/PO resources, we will be partnering with other SSERVI teams to implement future workshops.

Other VORTICES E/PO Activities

Training the Future Workforce

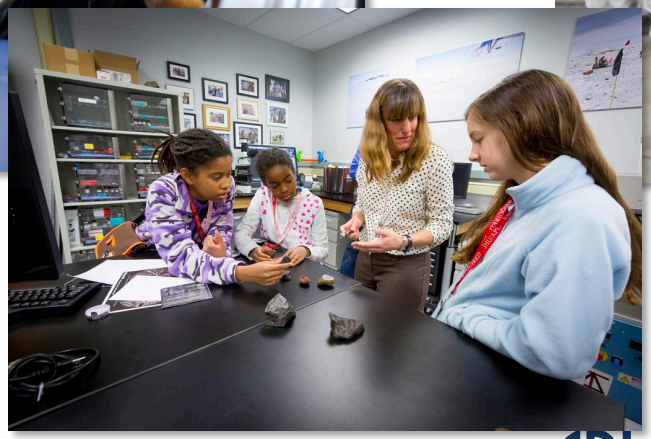
- High school Mentor Program at APL
  - Internships for qualified high school students who are placed one-on-one with a Laboratory staff member to either complete a science project or gain work experience for school credit.
- NASA/APL Summer Internship Program
  - Hands-on research opportunities for undergraduate and graduate students, mentored by the VORTICES team at APL
- Support for Post-doctoral researchers



Other VORTICES E/PO Activities

Attract and Retain Students in STEM Disciplines

- Space Academy for Middle School Students – 1/year
  - One-day event that includes a question and answer session with VORTICES scientists and engineers, and tours of APL's facilities.
  - Can partner with other APL-managed mission E/PO programs such as MESSENGER, MRO/ CRISM, New Horizons, etc.



Thank You!

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